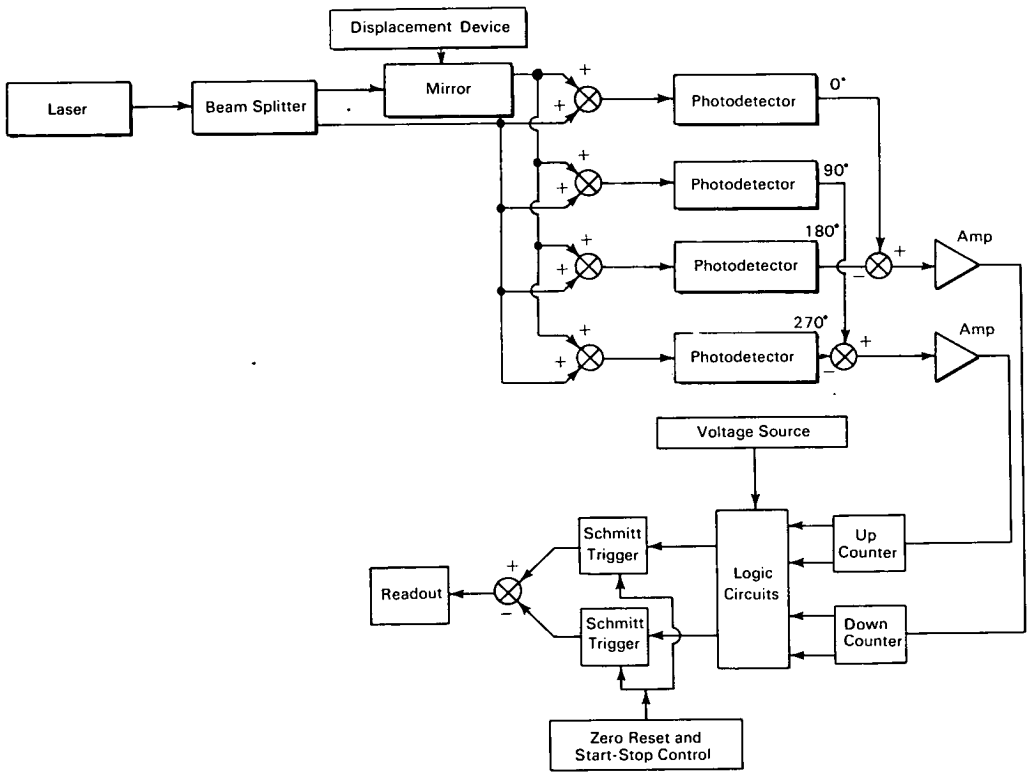
NASA TECH BRIEF

Interferometer Combines Laser Light Source and Digital Counting System



The problem: Devising an instrument for measuring small linear displacements with extreme accuracy and sensitivity. The instrument must provide digital indications of the magnitude and direction of the displacements.

The solution: An instrument that combines a digital electro-optical fringe-counting system with a Twyman-Green interferometer (amplitude splitter) using a laser light source to provide a coherent light beam at a fixed wavelength.

How it's done: The laser light source emits a narrow beam which is split into two components by the interferometer beam splitter. One beam component remains unchanged, but the path length of the other is changed by a mirror which is driven by the device whose linear displacement is to be measured. The resultant light beams are recombined (added) at the interferometer output to produce an interference pattern consisting of alternate light and dark fringes corresponding to the magnitude and direction of the displacement. A photodetector cell placed in the

(continued overleaf)

interference pattern reacts to the fringes to produce an electrical output corresponding to the magnitude of the displacement. Four cells are placed in different parts of the interference pattern to sense phase difference which is representative of the direction of displacement. The cells are wired in pairs (0° and 180°, 90° and 270°) to balance all dc levels to zero and to double the signal level. The outputs of the paired detectors will be 90° out of phase, leading or lagging, depending on the direction of displacement. These outputs are amplified and fed into digital logic circuits which count the fringes and determine the relative amplitude changes in each cell to provide a digital readout of the magnitude and direction of each displacement.

Notes:

1. This instrument will measure a linear displacement over a two-inch range with an accuracy of ±0.00000311425 inch.
2. Applications of this instrument are indicated wherever small linear displacements must be measured with extreme accuracy and sensitivity. This instrument may be used with seismographs, gyro-testing devices, film-thickness gages, vibration monitors, strain gages, and transducers for automatic machine tools.
3. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Manned Spacecraft Center
   P.O. Box 1537
   Houston, Texas, 77001
   Reference: B65-10161

Patent status: NASA encourages the immediate commercial use of this invention. It is owned by NASA and inquiries about obtaining royalty-free rights for its commercial use may be made to NASA, Code AGP, Washington, D.C., 20546.

Source: Massachusetts Institute of Technology under contract to Manned Spacecraft Center (MSC-151)